

Platacanthomyid remains from the late Cenozoic deposits of East China

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Abstract Remains of Platacanthomyidae from a late Cenozoic fissure in Fanchang, Anhui, and from the Miocene deposits of Sihong, Jiangsu, China are described. Three species and two genera, including two new species are recognized. They are *Neocometes sinensis* sp. nov. from Fanchang and Sihong, and *N. magna* sp. nov. and *Typhlomys* sp. from Fanchang. The Fanchang assemblage is a mixed sample with elements probably representing an interval spanning from the Early Miocene to the Pleistocene. Judging from fossil content and coloration in the sample, the two species of *Neocometes* are inferred to be Miocene in age, while the *Typhlomys* to be later. The joint occurrence of some typical Miocene elements in the assemblage seems to indicate that the Fanchang sample includes an association which can be closely correlated with the Early Miocene Sihong Fauna and the Shanwang Fauna of China, and with the Miocene faunas known from Thailand. Dental characters of *Neocometes* appear to suggest that the Asian species of the genus have undergone a rapid increase of size, heightening of dental crown, strengthening of ridges, and gradually development of ectoloph in the upper molars and endolophid in the lower molars, representing an evolutionary lineage different from that of Europe.

Key words Fanchang and Sihong, China; late Cenozoic; fissure-filling; Platacanthomyidae

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1 Introduction

Platacanthomyidae are a group of rodents showing affinities with cricetids, and characterized by their brachyodont and lophodont molars. Although there are different opinions in regard to their taxonomic position (as a separate family or a subfamily under Cricetidae or Muridae), platacanthomyids are considered to be useful, because of the wide paleogeographic distribution and relatively simple composition. The family are composed of three genera, one fossil genus *Neocometes* recorded in the Early to Middle Miocene of Eurasia, and two living genera *Platacanthomys* and *Typhlomys* locally distributed in southeastern Asia. Both *Platacanthomys*

and *Typhlomys* are recorded in Asia for the first time in the Late Miocene of Yunnan, China (Qiu, 1989). Generally, platacanthomyids are never very frequent in the fossil record. In China, *Platacanthomys*, with a handful of isolated teeth is only known from Yunnan, and *Neocometes*, before this, was documented by only one m3 from Jiangsu (Qiu and Qiu, 1995; Qiu, 2017).

The platacanthomyid materials described in this paper are mainly collected from Tangkou, a fissure at Laili Hill, Fanchang, Anhui Province by a team led by one of us (Jin C Z) funded by a program under the project “the State Key Scientific Research” (Jin and Wei, 1999). In addition, an m3 recently described as indeterminate *Neocometes* from the Early Miocene of Sihong, Jiangsu (Qiu, 2017), is restudied in this paper. The Fanchang sample was assembled throughout the fissure-fillings of the section. The assemblage of mammals is quite varied, including more than two dozen species of Insectivora, Chiroptera, Lagomorpha, Rodentia, Carnivora, Proboscidea, Perissodactyla, and Artiodactyla, as well as hominoids. The mammal association apparently is mixed, consisting taxa of different time intervals. The occurrence of *Democricetodon*, *Megacricetodon*, *Diatomys*, *Platybelodon* and *Kubanochoerus* in this sample obviously indicates a Miocene age, while *Leopoldamys*, a large-sized murine, suggests an age younger than the Early Pliocene. The Fanchang assemblage as it features in literature, could be ranging from Early Miocene to Pleistocene in age.

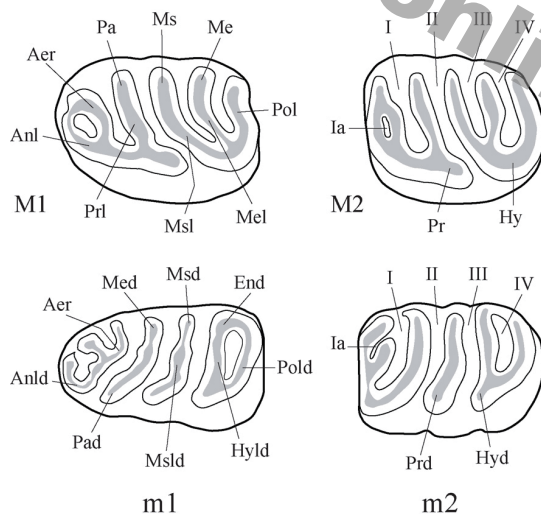


Fig. 1 Terminology of molar morphology for Platacanthomyidae

(modified after Fahlbusch, 1966 and Fejfar, 1999)

Abbreviations: Aer. anterior extra ridge; Anl. anteroloph; Anld. anterolophid; End. entoconid; Hy. hypocone; Hyd. hypoconid; Hyld. hypolophid; Me. metacone; Med. metaconid; Mel. metaloph; Mes. mesocone; Msd. mesoconid; Msl. mesoloph; Mslld. mesolophid; Pa. paracone; Pad. paraconid; Pol. posteroloph; Pold. posterolophid; Pr. protocone; Prd. protoconid; Prl. protoloph; Ia, I, II, III, IV. synclines Ia, I, II, III, IV

The purpose of the present paper is to describe the remains of platacanthomyids from these sites. Although the remains described are scarce and in a mixed sample resulting in difficulty of age assessment, they improve our knowledge of the spatial distribution of this family in the late Cenozoic. As well as, they contribute especially to a better understanding of the evolution of the interesting group of rodents, and to the paleobiogeographic relationships between Asia and Europe. For the geological background of the localities producing the material, the reader is referred to Qiu and Jin (2016). The dental morphology of lower and upper molars of platacanthomyids used in this text is given in Fig. 1.

2 Systematic description

Platacanthomyidae Alston, 1876

Neocometes Schaub & Zapfe, 1953

***Neocometes sinensis* sp. nov.**

(Figs. 2, 4)

Neocometes sp.: Qiu and Qiu., 1995, p. 61*Neocometes* sp.: Qiu and Qiu, 2013, p. 147*Neocometes* sp.: Qiu, 2017, p. 104

Etymology Sino-, Greek – China. Named after China, where the new species was found.

Holotype Left M1 (IVPP V 23396, from Tangkou, Fanchang, Anhui Province).

Paratype One eroded M1 and one damaged m1 (V 23397.1-2, from Tangkou, Fanchang, Anhui Province).

Referred specimen One m3 (V 23219, from Zhengji, Sihong, Jiangsu Province).

Measurements M1 (holotype), 2.05 mm×1.55 mm; M1 (paratype), 2.05 mm×1.35 mm; m3, 1.85 mm×1.45 mm.

Diagnosis Relatively large-sized species of *Neocometes*. Molars with relatively thick ridges and narrow synclines; M1 and m1 with slightly concave grinding surface, complete anteroloph(id) and pronounced syncline Ia; M1 subrectangular in outline, with buccally closed syncline Ia and IV; m1 with highly buccally closed syncline I and showing a higher connection between mesoconid and entoconid; m3 less reduced, with six diagonal/transversal ridges separated by five synclines.

Description The cheek teeth are unilaterally hyposodont, with the lingual distinctly higher than the buccal on the M1, the buccal higher than the lingual on the m1 and m3. Both M1 and m1 have a slightly concave grinding surface. The M1 is longer than wide, with nearly parallel lingual and labial walls. It consists of six thick diagonal/transversal ridges separated by five narrow synclines. The mesial angle of the middle ridges/synclines to the longitudinal axis is larger than 60°. The anteroloph is strong, anteriorly curved from the protocone to join the anterior extra ridge (Vqs) buccally. The anterior extra ridge is nearly as thick as other ridges, which is slightly constricted at the contact with the anteroloph. The protoloph is straight, with the smallest mesial angle to the longitudinal axis among the diagonal ridges (about 65°). The mesoloph is less straight than the protoloph, but is as thick and buccally free as the protoloph. The metaloph is narrow and nearly transverse, connecting with the mesoloph lingually and the posteroloph buccally. In the paratype the metaloph is distinctly constricted at the contact with the mesoloph. The posteroloph is transverse, and joins the hypocone and the metacone with the metaloph to form a continuous loop posteriorly. The endoloph is developed, but is interrupted by syncline II. The syncline Ia is narrow and laterally closed as an elongated oval basin. The syncline I is roughly parallel to the syncline Ia, but much wider and buccally opened. The syncline II is the widest and deepest among the synclines, deeply extending to the base of the crown lingually. It is lingually and buccally opened. The syncline III is similar to the syncline I in width and orientation. Both are lingually closed and buccally opened. The syncline IV is prominent and laterally closed.

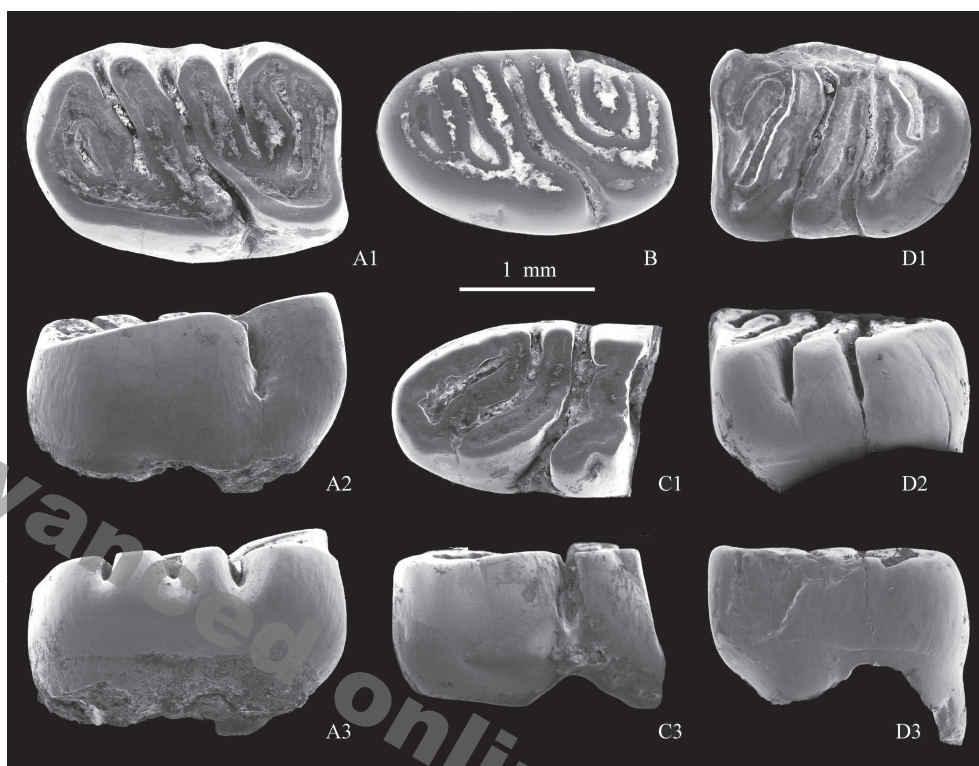


Fig. 2 Cheek teeth of *Neocometes sinensis* sp. nov. from Fanchang, Anhui and Sihong, Jiangsu
A. 1 M1 (IVPP V 23396, holotype), B. 1 M1 (V 23397.1), C. 1 damaged m1 (V 23397.2), D. 1 m3 (V 23219);
1, B. occlusal view, 2. lingual view, 3. buccal view

The m1 is damaged and its posterior portion is missing. The grinding surface is less concave than that of the M1, with the lateral margins being slightly convergent anteriorly. The anterolophid is pronounced and complete, and anteriorly curved. The equally developed anterior extra ridge joins the anterolophid to enclose the syncline Ia. The paraconid-metaconid connection extending from the metaconid to the paraconid is transverse in the lingual area, and then turns anterobuccally. It is touched but disconnected with the anterolophid buccally. The mesolophid is roughly parallel to the paraconid-metaconid connection, but thicker and narrower than it. The hypolophid is connected with mesolophid lingually, but disconnected with it buccally, judging from the broken vestiges. The syncline Ia is wide and laterally closed. The syncline I bends posterointernally, with the buccal portion being roughly parallel to the syncline Ia. It is lowly lingually opened, and highly buccally closes as marked by the shallow notch. The syncline II is deep, relatively transverse, and laterally opened. Judging from the vestiges, the buccal side of the syncline III is open, which deeply extends to the base of the crown as the syncline II, but the lingual side would be closed during the further wear.

The m3 is subrectangular, with nearly flattened grinding surface, straight anterior margin, curved posterior margin and nearly parallel lateral margins. It consists of six diagonal/

transversal ridges separated by five narrow synclines. The anterolophid is complete and straight, extending from the paraconid to the anterointernal corner of the tooth. The anterior extra ridge is quite developed, directing anterobuccal-posterolingually, connecting with the anterolophid buccally, and being free lingually. The paraconid-metaconid connection is thick and straight, and slightly constricted at the contact with the paraconid buccally and the endolophid lingually. The mesolophid is roughly parallel to the paraconid-metaconid connection, with the buccal portion thicker than the lingual one, and about 75° mesial angle to the longitudinal axis. The hypolophid is slightly curved backwards. It is narrower than the mesolophid, and has a free buccal end as the mesolophid does. The posterolophid is narrow but distinct, originating from the hypolophid buccal to midline of the tooth and extending to the base of the entoconid lingually. There is a tendency to develop an endolophid, and a continuous endolophid would appear with advanced wear of the tooth. The syncline Ia is small, narrow and located at anterolingual part of the tooth. It links the syncline I lingually. The syncline I is wide and laterally closed. It is more marked than the syncline Ia. The syncline II, the widest syncline of the tooth, is parallel to the syncline I. It is lingually closed and buccally opened, deeply extending to the base of the crown at the internal area. The syncline III is similar to, but shorter and narrower than the syncline II. The syncline IV is small, but larger than the syncline Ia. It is situated at the posterolingual part of the tooth as an elongated oval basin.

Comparison and discussion The described specimens from Fanchang are coloured grayish red and with trace by water transportation. They are inferred to be reworked elements from a lower level outside of the fissure-filling (Qiu and Jin, 2016). The m3 of the referred specimen was collected from the Xiacaowan Formation of Early Miocene in Sihong, Jiangsu Province (Qiu, 2017).

These specimens exhibit a suite of characters which are highly diagnostic for the genus *Neocometes*, i.e. the concave grinding surface on M1 and m1, the distinctly inclined ridges/synclines (with a mesial angle to the longitudinal axis being larger than 60°), and the open of the mid-buccal synclines in upper molars and mid-lingual synclines in lower molars. By the characters, they can be distinguished from those of *Typhlomys* and *Platacanthomys* of the family Platacanthomyidae.

Three species of *Neocometes*, *N. similis* and *N. brunonis* from Europe, and *N. orientalis* from Asia (Thailand), are known from the Miocene (Schaub and Zapfe, 1953; Fahlbusch, 1966; Fejfar, 1974, 1999; Fejfar and Kalthoff, 1999; Mein et al., 1990; Mein and Ginsburg, 1997). The Chinese taxon represented by these specimens seems to be different from all the known species, and is here proposed to define as new species of *Neocometes*.

The new species *Neocometes sinensis* differs from *N. similis* from the Early Miocene (MN 4) in larger size (Fig. 4), in M1 having a rectangular occlusal surface (the anterior portion is distinctly narrower than the posterior in *N. similis*), and a buccally closed syncline IV (generally the syncline is opened buccally in *N. similis*), m1 having a shallowly buccally opened syncline I (the syncline in *N. similis* is distinctly closed buccally) and a tendency of closing synclines

Ia and IV linguallly (all synclines are opened linguallly in *N. similis*), and in m3 being less reduced (see Fejfar, 1974). It is close to *N. brunonis* in size, but can be differentiated from the European Middle Miocene species by the first molars having more complete anteroloph(id) and syncline Ia, plus by their morphological characters for distinguishing from *N. similis*. Fejfar (1999) called an intermediate form between *N. similis* and *N. brunonis* as *Neocometes* cf. *N. similis*, and considered the European *Neocometes* to demonstrate evolution from *N. similis* to *Neocometes* cf. *N. similis* to *N. brunonis*. Morphological changes of molars in this lineage are modest in the span of 7 Ma, only showing somewhat increasing of size and simplifying of the anteroloph(id) of the first molars. The Chinese new form is distinguished from all the European species of the genus in having a developed anteroloph and buccally closed synclines IV on M1, complete anterolophid and nearly linguallly closed synclines Ia and IV on m1.

Neocometes sinensis is similar to *N. orientalis* from Li Basin, Thailand, in having prominent anteroloph(id) and anterior extra ridge in the first molars, buccally closed syncline IV on M1, but differs from it in larger size, having stronger ridges relative to the synclines, buccally closed syncline Ia on M1, and on m1 having complete and closed syncline Ia, nearly buccally closed syncline I and distinctly linguallly opened syncline I and II. On the basis of size, dental characters, and comparison with its European relatives, *N. orientalis* was considered to be more primitive than *N. similis*, the oldest European species that appears in the MN4, and suggested an Early Miocene age for the Li locality (Mein et al., 1990, 1997). Subsequent discovery of *Neocometes* cf. *N. orientalis* in the Middle Miocene Na Khaem Formation of the Mae Moh Basin in northern Thailand shows that the Li mammalian fauna to be the same age as the *Neocometes* cf. *N. orientalis*-bearing beds in the Mae Moh Basin (Chaimanee et al., 2007). Thus, the age of the Li fauna, containing *N. orientalis* is considerably younger than conjectured by previous authors. Moreover, Chaimanee et al. (2007) pointed out that *Neocometes* cf. *N. orientalis* shares distinct morphological characteristics with *N. orientalis* from Li Basin. Those characters, such as the closure of the ectoloph on the upper molars and the complete endolophid on the lower molars, are functionally important, which occur in living *Typhlomys*, but are never encountered among European species of *Neocometes*. Therefore, they considered that the Thailand specimens may preclude their attribution to the genus *Neocometes*, but may need to be referred to a new genus that is closely related to the extant *Typhlomys*.

Although both *N. orientalis* and *N. sinensis* show some dental characters different from the European species of *Neocometes*, it would be better to retain provisionally their attribution to the genus *Neocometes*, until sufficient information on morphology is known. So far as the dental morphology is concerned, these specimens show more similarities to *Neocometes* rather than to *Typhlomys*, because they have more open synclines, and distinctly steeper ridges and synclines than in *Typhlomys*. It is true that the syncline IV on the M1 of the Asian species is buccally closed, but a complete ectoloph is unformed on this molar and the mid-buccal synclines are still buccally open as in the European species. The synclines I and II on

the m1 of *N. sinensis* are distinctly lingually opened, a complete endolophid as in *Typhlomys* is absent. Morphological differences of *Neocometes* between Asian and European species, e.g. the presence of buccally closed synclines IV on M1, and m1 showing a tendency of the closing of all lingual synclines (or relatively lower closing of the synclines) in the Asian forms, are considered to indicative of a different specific status, and probably represent two different evolutionary lineages of the genus. In addition, the small size, the thin ridges and wide synclines, the complete anteroloph(id)s and pronounced syncline Ia, and the presence of six ridges on m3 can be interpreted as primitive characters for *Neocometes*. On the basis of this conjecture, the new species *N. sinensis* seems to be more derived than *N. orientalis*, but primitive than *N. brunonis* of Europe.

A recent description of m1 from the Miocene Bukpyeong Formation, South Korea, under the name *Neocometes* aff. *N. similis*, appears to be another evidence in Asia to show close faunal affinity to European *Neocometes* (Lee and Jacobs, 2010). The m1 is highly similar to *N. similis* of Europe in size and morphology, with inclined ridges/synclines to the longitudinal axis of tooth, and distinctly lingually opened synclines I-IV. The m1 of *N. sinensis* differs from that of *Neocometes* aff. *N. similis* in larger size (Fig. 4), higher crown, and in having a highly buccally closed syncline I and a high connection between the mesoconid and entoconid. *N. sinensis* probably is more derived than *Neocometes* aff. *N. similis* in the evolution stage.

***Neocometes magna* sp. nov.**

(Figs. 3, 4)

Etymology Magnus, Latin – large, great. Referring to the large size of the new species.

Holotype Left m1 (IVPP V 23398, from Tangkou, Fanchang, Anhui Province).

Paratype One M2, one m2, and one eroded m3 (V 23399.1-3, from Tangkou, Fanchang, Anhui Province).

Measurements M2, 2.95 mm×2.45 mm; m1 (holotype), 3.45 mm×2.25 mm; m2, 3.20 mm×2.35 mm.

Diagnosis Gigantic species of *Neocometes*. Molars with strong and crowded ridges, and slightly concave grinding surface; M2 and m2 with prominent anterior extra ridges, but poorly developed syncline Ia; continuous endoloph and ectoloph appearing in worn M2; lower molars showing a tendency of closing lingual synclines; m1 with nearly buccally closed syncline I.

Description The cheek teeth are unilaterally hyposodont, with the lingual higher than the buccal on the M2, the buccal higher than the lingual on the m1-m3. The grinding surfaces are slightly concave. The M2, determined by distinctly wear facet on its anterior and posterior sides, is subrectangular. It is in late stages of wear, with appearance of continuous endoloph and ectoloph. It is composed of six diagonal/transversal ridges and five narrow and small synclines. The anteroloph is fused with the anterior extra ridge to form a strong transverse ridge anteriorly. The protoloph is rather thick, with an about 75° mesial angle to the longitudinal axis. The mesoloph is the widest among the diagonal/transversal ridges, and

almost as thick as, and nearly parallel to the protoloph. The metaloph is narrower and weaker than the protoloph. The posteroloph is relatively thin, posteriorly curved from the hypocone to join the metaloph buccally. The endoloph is much stronger than the ectoloph. On the ectoloph, the buccal connections of the synclines II and III are rather weak, indicating interruption of the ectoloph in early stages of wear. The presence of syncline Ia is suggested by a string-shaped basin in the anterior ridge buccal to the midline of the tooth. The syncline I is pronounced and buccally closed. The syncline II is the widest among the synclines, and laterally closed at the present stages of wear. It is lingually and buccally opened. The syncline III is similar to the syncline I and II in shape and orientation, but is the narrowest. The syncline IV is narrow and laterally closed, and slightly curved posteriorly. The lingual root is very strong.

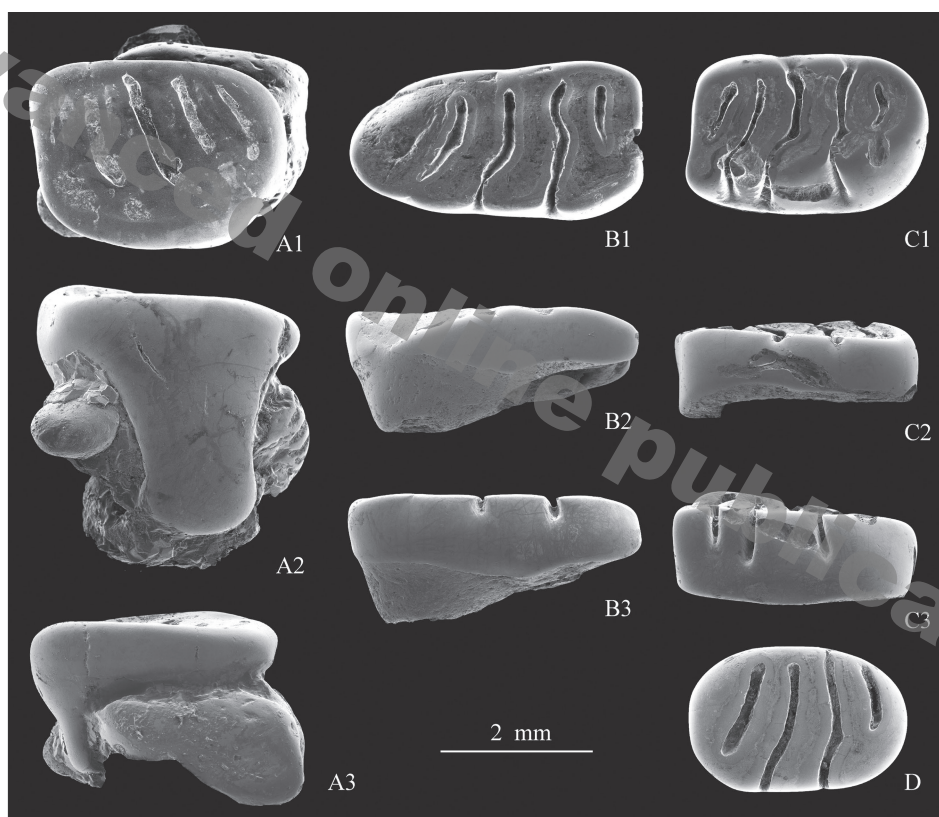


Fig. 3 Cheek teeth of *Neocometes magna* sp. nov. from Fanchang, Anhui
A. 1 M2 (IVPP V 23399.1), B. 1 m1 (V 23398, holotype), C. 1 m2 (V 23399.2), D. 1 m3 (V 23399.3);
1, D. occlusal view, 2. lingual view, 3. buccal view

The m1 is long pear-shaped, consisting of six diagonal/transversal ridges and five narrow synclines. It is in late stages of wear, with appearance of continuous endolophid and eroded anterolophid and syncline Ia. The grinding surface is slightly concave. The anterolophid is prominent and anteriorly curved. The anterior extra ridge is developed, having an about 70° mesial angle to the longitudinal axis. It joins the anterolophid laterally to enclose the

syncline Ia. The paraconid-metaconid connection is thick and slightly curved anterobuccal-posterolingually, with an about 85° mesial angle to the longitudinal axis in the lingual area. It is touched with the anterolophid buccally and joins the endolophid lingually at this stage of wear. The mesolophid is as thick as the paraconid-metaconid connection, with the more buccally striking than lingually. It is roughly transverse in the lingual part, but bends anterobuccally. The ridge is free buccally. The hypolophid is transverse, and is narrower and weaker than the mesolophid. It is touched with the mesolophid lingually. The posterolophid is parallel to, but narrower and weaker than the hypolophid. It joins the hypoconid buccally and the hypolophid lingually to form a continuous loop posteriorly. The endolophid is continuous, on which the lingual connections of synclines II and III are weak, probably indicating the presence of a discontinuous endolophid in early stages of wear. The presence of syncline Ia is suggested by a furrow in anterior part of the tooth, but no sign of a distinct outline of syncline can be detected. The laterally closed syncline I is roughly anteroexternal-posterointernally orientated. The syncline II is more or less parallel to the syncline I, buccally opened and lingually closed. The syncline III is wide and transverse. It is buccally opened and lingually closed as the syncline II. The syncline IV is narrow and transverse, and laterally closed as an elongated basin in the posterolingual portion.

The m2 is subrectangular, with straight anterior margin, slightly curved posterior margin and nearly parallel lateral margins. The grinding surface is somewhat concave, consisting of six thick diagonal/transversal ridges and five narrow synclines. It is in early stages of wear, with interrupted endolophid. The anterolophid is straight, extending from the paraconid to the anterointernal corner of the tooth. The anterior extra ridge extends posterointernally from the paraconid to join the anterolophid lingually to enclose the syncline Ia. The paraconid-metaconid connection is thick and roughly parallel to the anterior ridge, with an about 80° mesial angle to the longitudinal axis. It is disconnected with the anterolophid buccally but connected with the endolophid lingually. The mesolophid is the widest and strongest among the ridges. It is orientated nearly transversely in the lingual part, but bends anterobuccally in the buccal one. The ridge is free laterally. The hypolophid is roughly parallel to the mesolophid, and slightly constricted at the contact with the hypoconid buccally. It is close against the mesolophid buccally, and connected with the posterolophid lingually. The posterolophid is narrow, but still thick. It is curved posteriorly, extending from the hypoconid to the entoconid to form a continuous loop posteriorly. The syncline Ia is narrow and wide, as a closed furrow obliquely situated in anterior part of the tooth. The syncline I is narrow and slightly posteriorly curved, lingually closed and buccally opened, deeply extending to the base of the crown at the external area. The syncline II is laterally opened, with the lingual part more transverse and wider than the buccal one. It deeply extends to the base of the crown at the external area. The syncline III is similar to the syncline II, but narrower. The syncline IV is narrow, and laterally closed as a posteriorly curved furrow.

The m3 is very eroded by water transportation. The presence of six diagonal/transversal

ridges and five synclines can be determined. The anterolophid and the anterior extra ridge are merged into one strong ridge located in the anterolingual corner of the tooth, and the syncline Ia is obliterated. The mid-ridges are similar to those of the m2 in shape and orientation, except for the less anterobuccally bending of the mesolophid, and the slightly anterolingual direction of the mesolophid and hypolophid lingually. The presence of the syncline Ia is suggested by vestige. The syncline I is wide and laterally closed. The syncline II is nearly parallel to the syncline I. It is lingually closed and buccally opened. The syncline III is laterally opened, and directed anterointernally in the lingual part. The syncline IV is prominent and slightly directed anterolingual-posterobuccally.

Comparison and discussion The specimens described are coloured grayish red and with trace by water transportation. They are inferred to be produced from a lower level outside of the fissure-filling (Qiu and Jin, 2016).

The material fits the diagnosis of *Neocometes* Schaub & Zapfe, 1953 by their slightly concave grinding surface with six diagonal/transversal crests separated by five synclines, distinctly inclined synclines/ridges, and the open of the mid-lingual synclines in lower molars in early stages of wear. By these characters, they are distinguishable from those of *Typhlomys* and *Platacanthomys* in the family Platacanthomyidae.

As mentioned above, four species of *Neocometes*, *N. similis* and *N. brunonis* from Europe, *N. orientalis* from Thailand, and the new species *N. sinensis* from Anhui, China, are recorded in the Miocene (Schaub and Zapfe, 1953; Fahlbusch, 1966; Fejfar, 1974; Mein et al., 1990; this paper). The Fanchang specimens represent another new and gigantic species of *Neocometes* found in Anhui, which is much larger than all the known species (Fig. 4). In addition to size difference, the new species can be distinguished from *N. orientalis* by its stronger and crowded ridges, relatively small syncline Ia, narrower syncline IV, more distinct endolophid on m1 and m2, nearly buccally closed syncline I on m1, and stronger anterior extra ridge and buccally opened syncline I on m2. The Chinese species is similar to *N. similis* in having a poorly developed syncline Ia on M2 and m2, but differs from the European species in having more crowded ridges, distinctly developed endoloph and ectoloph on M2, buccally closed syncline I on m1, and low endolophid tending to close the lingual synclines on m1 and m2. It shows some similarities to *N. brunonis* in having relatively crowded ridges and narrow synclines on molars, poorly developed synclines Ia on M2 and m2, and buccally closed syncline I on m1, but differs in having stronger ridges on molars, in M2 having low endoloph and ectoloph tending to laterally close all the synclines, m2 having buccally opened syncline I, and m1 and m2 having low connections to close the synclines lingually. Due to the scarcity of material, the new species has no much that can be directly compared with *N. sinensis* from the same fissure filling of Fanchang in morphology. It is worth noting that the two new species show some similarities in dental morphology, such as the crowded ridges, the low endolophid tending to close the synclines lingually on lower molars, and the presence of buccally closed syncline I on m1. Nevertheless, they cannot be identified as the same species because of size

difference (Fig. 4). In addition, *N. magna* has a more reduced syncline Ia on m3 than in *N. sinensis*. *N. magna* shows some similarities to *Neocometes* aff. *N. similis* from the Miocene of South Korea in the m1 having strong and crowded ridges, narrow synclines, and complete anterolophid and anterior extra ridge, but is easily to distinguished from it in its larger size, and the developed endolophid of m1.

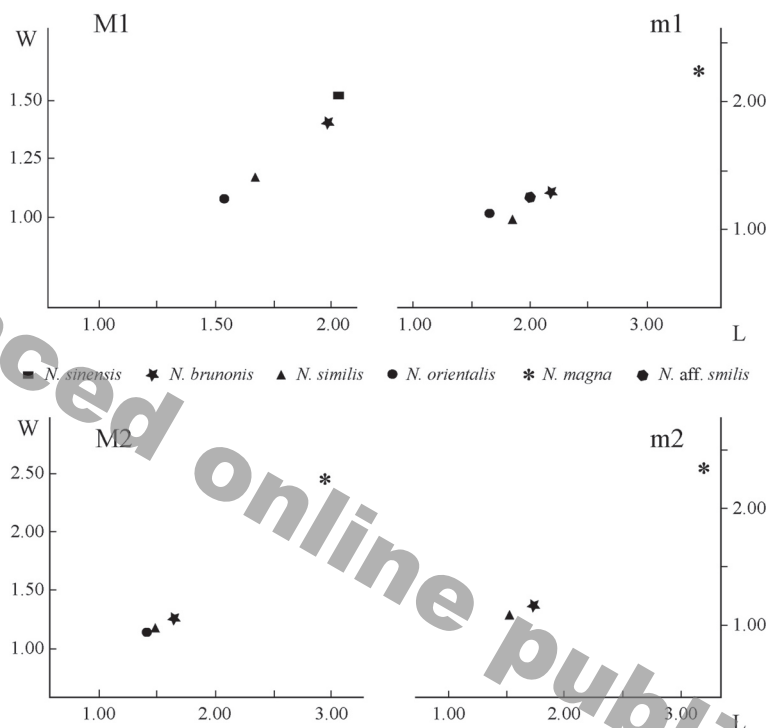


Fig. 4 Scatter diagrams showing length and width of the first and second molars of the known species of *Neocometes* from Eurasia
Data for *N. brunonis* and *N. similis* are averages cited from Schaub & Zapfe, 1953 and Fahlbusch, 1966, respectively, for *Neocometes* aff. *N. similis* cited from Lee and Jacobs, 2010

The new species *Neocometes magna* displays similarities with *N. sinensis* and *N. orientalis* in the development of anterolophid and anterior extra ridge, and the tendency of forming an endolophid and closing of the lingual synclines in m1 and m2. On the contrary, the European Miocene species of *Neocometes* have relatively weak anterolophid and extra ridge, but distinctly laterally opened synclines I, II and III in the lower molars. This seems to suggest again the existence of different evolutionary lineages of *Neocometes* between Asia and Europe.

Among the Asian species of *Neocometes*, *Neocometes* aff. *N. similis* shows closer morphology to European species than the others in having linguallly opened synclines I-IV on m1. That is to say, an endolophid is absent in this form of Early Miocene. The new species *N. magna* and *Neocometes* cf. *N. orientalis* from Mae Moh, Thailand, however, demonstrate developed ridges and endolophids, which are more distinct than in *N. orientalis* and *N. sinensis*. Thus, there seems to be a possibility that an evolutionary trend in Asian *Neocometes*

is towards the strengthening of the diagonal/transversal ridges, the development of endolophids in the lower molars and ectolophids in the upper molars, as well as the quickly increased size.

The gradual increasing of the size during the Miocene is considered to be an evolutionary tendency of *Neocometes* (Fejfar, 1999). If this assumption is correct, *N. magna* would be younger than *N. sinensis*, and the youngest among all the known species of the genus. Nevertheless, the age of either *N. magna* or *N. sinensis* is difficult to evaluate because their remains were collected from fissure deposits of late Cenozoic, and the sample is a mixed assemblage with elements representing a rather long interval spanning, probably ranging from Early Miocene to Pleistocene (Qiu and Jin, 2016). Although they are inferred to be reworked elements from earlier levels, assessment of their precise ages needs further discovery and study of more complete material. However, on the basis of the Early and Middle Miocene appearance of all the known species of *Neocometes* in Eurasia (Schaub and Zapfe, 1953; Fahlbusch, 1966; Fejfar, 1974, 1999; Qiu, 2017), and of the occurrence of some taxa associated with *Neocometes* in the assemblage, such as *Diatomys*, *Democricetodon*, *Megacricetodon*, *Platybelodon* and *Kubanochoerus* which are typical elements of Early or Middle Miocene in European or Asian faunas, the *Neocometes* in the Fanchang are mostly probably of Miocene in age.

Typhlomys Milne-Edwards, 1877

Typhlomys sp.

(Fig. 5)

Referred specimens One damaged m1, two m2 (IVPP V 23400.1-3, from Tangkou, Fanchang, Anhui Province).

Measurements m2, 1.35 mm×0.90 mm, 1.40 mm×0.90 mm.

Description The m1 is preserved only the anterior portion. The anterolophid is complete and slightly curved anteriorly. The anterior extra ridge joins the anterolophid laterally to enclose the syncline Ia. The paraconid-metaconid connection is slightly curved postero-externally, with an about 55° mesial angle to the longitudinal axis. It is connected with the anterolophid buccally and joins the endolophid lingually. The syncline Ia is pronounced, situated as an oval basin at anterolingual part of the tooth. The laterally closed syncline I is wide, and is roughly parallel to the syncline Ia. The syncline II is buccally opened and lingually closed.

The two m2 are well preserved and in early stages of wear. The tooth is subrectangular, with slightly concave grinding surface, straight anterior margin, parallel lateral margins, and postero-buccally contracted posterior margin. It consists of six diagonal/transversal ridges and five synclines. The anterolophid is straight and relatively thin, extending from the paraconid to the anterointernal corner of the tooth. The anterior extra ridge is complete, extending posterointernally from the paraconid to join the endolophid lingually. The paraconid-metaconid connection is long, with the buccal portion thicker than the lingual one, and an about 55° mesial angle to the longitudinal axis. It is connected with the anterolophid buccally and the

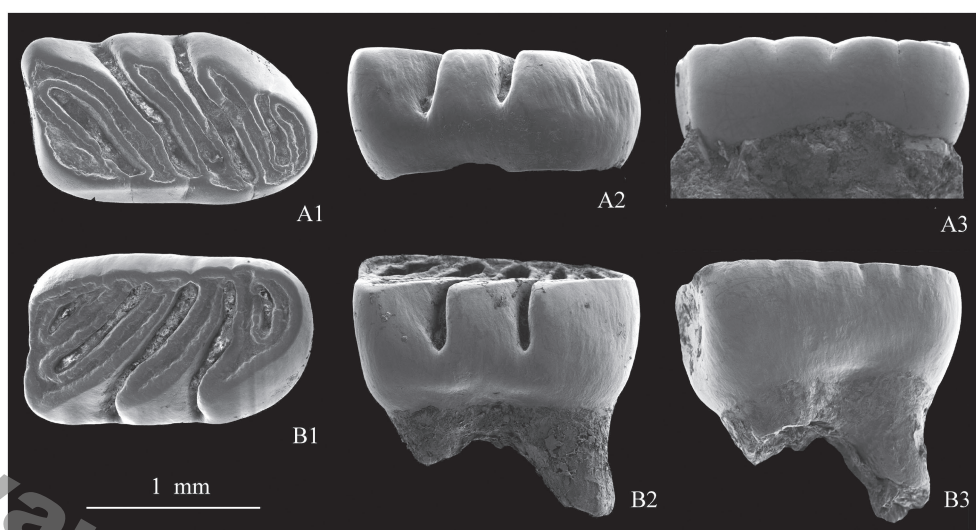


Fig. 5 Cheek teeth of *Typhlomys* sp. from Fanchang, Anhui

A. r m2 (IVPP V 23400.3), B. l m2 (V 23400.2); 1. occlusal view, 2. buccal view, 3. lingual view

endolophid lingually. The mesolophid is similar to the paraconid-metaconid connection, but narrower and free buccally. It is roughly parallel to the paraconid-metaconid connection and the anterior extra ridge. The hypolophid is narrower than the mesolophid, and relatively transverse in direction. It is free buccally, and connected to the endolophid lingually. The posterolophid is narrow, extending from the hypolophid buccally to midline to connect with the hypolophid to form a continuous loop posteriorly. The syncline Ia is prominent and larger than the syncline IV in one specimen, and very narrow and shallow, and smaller than the syncline IV in the other. The syncline I is pronounced, and laterally closed. The syncline II is the widest among the synclines. It is buccally opened and lingually closed, deeply extending to the base of the crown at the external area. The syncline III is similar to the syncline II, but narrower. The syncline IV is narrow and small, and may be buccally opened in the fresh specimens.

Comparison and discussion The Fanchang specimens can be confidently assigned to *Typhlomys* because it exhibits the following suite of dental characters: 1) small-sized and brachydont molars; 2) the concave grinding surface with six diagonal/transversal crests and five synclines; 3) the moderately inclined mid-synclines/ridges; 4) the continuous endolophid and the lingually closed synclines. In these characters, they are different from those of *Neocometes* and *Platacanthomys* in the family Platacanthomyidae.

Typhlomys is a monospecific living genus distributed in the Oriental Region. Six fossil species of the genus from the late Cenozoic deposits, *T. primitivus*, *T. hipparionus*, *T. intermeius*, *T. macrourus*, *T. cinereus* and *T. anhuiensis* have been documented (Qiu, 1989; Zheng, 1993; Jin et al., 2009). The dental pattern of *Typhlomys* seems to be quite stable. The changes which took place between *T. primitivus* of Late Miocene and *T. cinereus* of the Recent are rather small, consist of a slight increase in size, slight enlargement of the anterior extra

ridge of the upper molars and reduction of the third molars. Definition of these taxa was mainly based on size difference, and interspecific distinction is subtle. The few described specimens from Fanchang show similarities with the corresponding teeth of *T. intermeius*, *T. cinereus* and *T. anhuiensis* in size and morphology, but do not allow to define a separate and reliable species.

3 Conclusion

The specimens described from Anhui and Jiangsu, eastern China are included in two genera and three species, belonging to the family Platacanthomyidae, i.e. *Neocometes sinensis* sp. nov., *N. magna* sp. nov. and *Typhlomys* sp. Although the materials are small, they have broadened our knowledge of the rodent family.

The Eurasian distributed fossil genus *Neocometes* there exists a general evolutionary trend of size. Nevertheless, in the European species, syncline I, II, III and IV of M1 are buccally opened, syncline I, II and III of m1 are linguallly opened; while in the Asian species, except the Early Miocene *Neocometes* aff. *N. similis* from South Korea, the syncline IV of M1 is buccally closed, syncline I, II and III of m1 have more or less lingual connection, displaying a tendency of forming an endolophid. The morphological differences probably imply that there are two different evolutionary lineages in *Neocometes* between Asia and Europe. The Asian species, which starting with *Neocometes* aff. *N. similis* might be followed via *N. orientalis* and *N. sinensis* until *N. magna*, seem to have undergone a rapid increase of size, crown, strengthening of ridges and gradual development of lateral ridges.

The platacanthomyid remains are from a mixed assemblage of fissure filling with elements representing a rather long interval spanning. The age of these taxa is difficult to assess because of the inadvertent sampling and the inadequate materials. Judging from the transported trace and the coloration of fossils, remains of *Neocometes* are probably from the lower levels of the deposits, and *Typhlomys* from the upper. A precise assessment of their ages must await further discovery and study of more complete material. Nevertheless, based on the Early and Middle Miocene appearance of *Neocometes* in Eurasia, and the presence of some typical Early or Middle Miocene elements in the assemblage, the *Neocometes* is inferred to be associated with the Miocene taxa and is probably of Miocene in age. The *Typhlomys* from this fissure is considered to be a later age.

The Fanchang assemblage has *Plesiosciurus*, *Diatomys*, *Democricetodon* and *Megacricetodon* as well as *Neocometes* in common with the Sihong Fauna, and has *Plesiosciurus* and *Diatomys* in common with the Shanwang Fauna. In addition, it shares *Diatomys*, *Democricetodon* and *Neocometes* with the Miocene fauna from Li Basin and *Neocometes* with the Mae Moh Basin, Thailand. This seems to indicate that the fissure assemblage contains an association, which can be closely correlated to the Miocene faunas of Asia.

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中国东部晚新生代堆积中的刺山鼠化石

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摘要: 描述了安徽繁昌和江苏泗洪新发现的晚新生代堆积物中的刺山鼠科化石。化石共有两属3种, 即产自安徽、江苏的中华新来鼠(新种) (*Neocometes sinensis* sp. nov.)和产自安徽的大新来鼠(新种) (*N. magna* sp. nov.)及猪尾鼠未定种(*Typhlomys* sp.)。安徽繁昌的材料来自裂隙堆积, 采样时未作分层处理, 对单个化石属种很难进行准确的时代确定; 但根据所采集化石的组分和上下层位保存的颜色与埋葬方式上的差异, 推测*Neocometes*的时代为中新世, 而*Typhlomys*可能较晚。*Neocometes*属的出现和典型中新世动物成员的存在, 表明繁昌这一含古猿的裂隙堆积中含有大致与江苏泗洪动物群和山东山旺动物群相当、甚至可与泰国中新世动物群对比的啮齿动物组合。新种牙齿的形态特征显示, *Neocometes*属在亚洲经历了个体迅速增大, 齿冠增高, 齿脊增强, 上臼齿外脊和下臼齿内脊逐渐发育的过程, 与该属在欧洲的演化趋势有所不同。

关键词: 安徽繁昌, 江苏泗洪, 晚新生代, 裂隙堆积, 刺山鼠科

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